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Paints and varnishes — Pendulum damping test

Peintures et vernis — Essai d'amortissement du pendule

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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 35, *Paints and varnishes*, Subcommittee SC 9, *General test methods for paints and varnishes*, in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 139, *Paints and varnishes*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This fourth edition cancels and replaces the third edition (ISO 1522:2006), which has been technically revised.

The main changes are as follows:

— Clause 3 “Terms and definitions” has been added.

— The recommendation of using metal or glass panels has been removed from 7.1 because the test method is also usable for other substrate materials, e.g. plastics.

— The precision statement of the König Pendulum in 10.1 has been corrected reflecting the test conditions and results of the interlaboratory comparison in 2006.

— In 5.1.3 and in B.3.2 the tolerance for the time for the amplitude of swing to decrease from 12° to 4° has been changed back to ±10 s, as it was in the second edition (ISO 1522:1998).

— The calibration of the pendulum has been added with a test for deformation.

— The text has been editorially revised and the normative references have been updated.

Any feedback or questions on this document should be directed to the user’s national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

This document considers in detail two test procedures for pendulum damping tests, König and Persoz. The instruments embody the same principle, i.e. that the amplitude of oscillation of a pendulum touching a surface decreases more rapidly the softer the surface, but differ in respect of dimensions, period and amplitude of oscillation.

The interaction between the pendulum and the paint film is complex, depending as it does on both elastic and viscoelastic properties, and it is not possible to establish a general relationship between results obtained by the two tests. Therefore, only one type of pendulum should be used in a given series of measurements of damping time.

The following considerations may serve as a guide when considering which pendulum may offer an advantage for a particular purpose.

a) On surfaces with a low coefficient of friction, the Persoz pendulum may skid, which would invalidate results; however, this occurs only rarely with paints and varnishes.

b) It should be noted that both instruments reflect the sensitivity of the physical properties of a paint to its environment, and the test therefore should be under controlled conditions of temperature and humidity and in the absence of draughts. The thickness of the paint film and the nature of the substrate may also affect the damping times.

Paints and varnishes — Pendulum damping test

1 Scope

This document specifies two methods of carrying out a pendulum damping test on a coating of paint, varnish or other related products. It is applicable to single coatings and to multicoat systems.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 1513, *Paints and varnishes — Examination and preparation of test samples*

ISO 1514, *Paints and varnishes — Standard panels for testing*

ISO 2808, *Paints and varnishes — Determination of film thickness*

ISO 4618, *Paints and varnishes — Terms and definitions*

ISO 15528, *Paints, varnishes and raw materials for paints and varnishes — Sampling*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 4618 apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

4 Principle

A pendulum resting on a coating surface is set into oscillation and the time for the oscillation amplitude to decrease by an amount specified in this document is measured. The shorter the damping time, the lower the hardness.

5 Apparatus

5.1 Pendulum

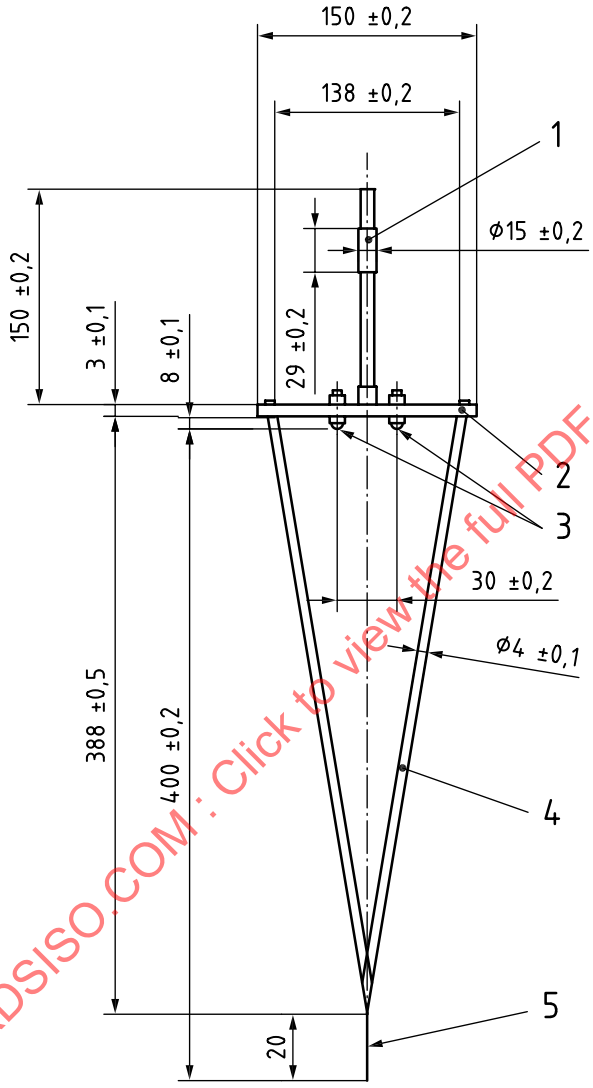
5.1.1 Both the pendulums, as described in 5.1.2 and 5.1.3, comprise an open framework connected by a cross-bar on the under face of which two balls are inset to serve as the fulcrum, the lower end of the framework being formed into a pointer. The two pendulums differ in shape, mass, swinging time and other details, as described in 5.1.2 and 5.1.3.

The pendulum shall be used away from draughts and vibrations.

The use of a protective enclosure is recommended.

5.1.2 The König pendulum (see Figure 1) rests on two tungsten-carbide balls of (5 ± 0,005) mm diameter, of hardness (1 600 ± 32) HV 30[1)], and (30 ± 0,2) mm apart and is counterpoised (to adjust the natural frequency of oscillation) by means of a weight sliding on a vertical rod attached to the cross-bar. On a polished plate-glass panel, the period of oscillation shall be (1,40 ± 0,02) s and the time for damping from a 6° displacement to a 3° displacement shall be (250 ± 10) s. The total mass of the pendulum shall be (200 ± 0,2) g.

Dimensions in millimetres



Key

1	counterpoise (adjustable)	4	frame
2	cross-bar, width 12 ± 0,1	5	tip
3	ball, Ø 5 ± 0,005		

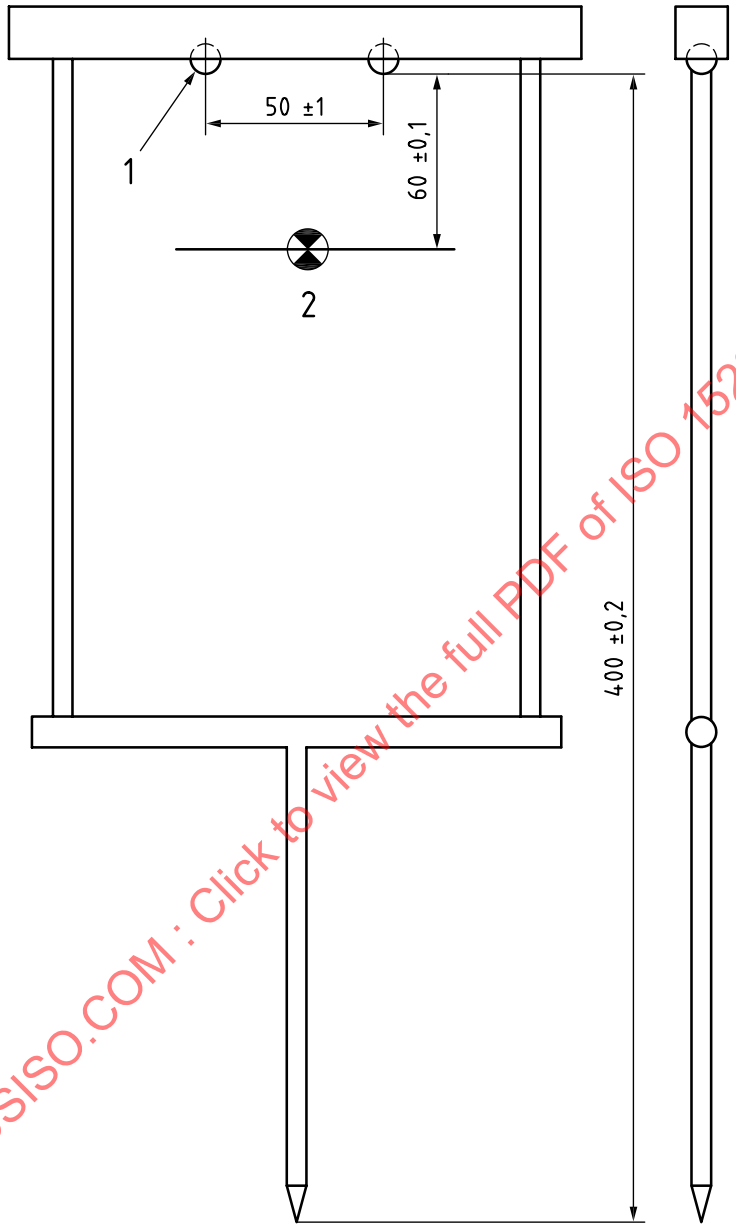
Figure 1 — König pendulum

5.1.3 The Persoz pendulum (see Figure 2) rests on two tungsten-carbide balls of (8 ± 0,005) mm diameter, of hardness (1 600 ± 32) HV 30[1)], and (50 ± 1) mm apart. A counterpoise is not provided. On a polished plate-glass panel, the period of oscillation shall be (1 ± 0,01) s and the time for damping from a 12° displacement to a 4° displacement on the same substrate shall be (430 ± 10) s. The total mass of the

1) HV: Vickers hardness determined according to ISO 6507-1.

pendulum shall be (500 ± 0,1) g and its centre of gravity at rest shall be (60 ± 0,1) mm below the plane of the fulcrum, the pointer tip being (400 ± 0,2) mm below the plane of the fulcrum.

Dimensions in millimetres



Key

1 ball, Ø 8 ± 0,005

2 centre of gravity

Figure 2 — Persoz pendulum

5.2 Instrument stand

The stand for supporting test panel and pendulum is common to both pendulums and comprises a heavy supported vertical rod to which is attached a horizontal table with a flat working surface, the dimensions of which may conveniently be 95 mm × 110 mm and not less than 10 mm thick. The stand also has a stirrup to support the pendulum away from the table and a mechanism for shock-free lowering of the pendulum on to the test panel.

5.3 Scale

The front of the stand shall be marked to show angular displacement of the pendulum from a centre point, indicating the rest position of the pendulum, through 6° and 3° for a König pendulum and through 12° and 4° for a Persoz pendulum. The scale may be moved horizontally, and locked in position so that the zero marking and the test position of the pendulum tip coincide. This scale may be marked on a mirror, or a mirror may be placed behind the scale, to assist in eliminating parallax errors during observation.

5.4 Stopwatch, or other timing device, for timing the oscillation damping of the pendulum.

5.5 Polished plate (float) glass panel, for calibrating the pendulum.

6 Sampling

Take a representative sample of the product to be tested (or of each product in the case of a multicoat system), as specified in ISO 15528.

Examine and prepare each sample for testing, as specified in ISO 1513.

7 Test panels

7.1 Substrate

Select the substrate from one of those specified in ISO 1514, ensuring that the panels are plane, rigid and free from distortion. The test panel shall have dimensions of approximately 100 mm × 100 mm × 5 mm.

7.2 Preparation and coating

Unless otherwise specified, prepare each test panel in accordance with ISO 1514 and then coat it by the specified method with the product or system under test. The test coating shall then be smooth and free from surface irregularities.

7.3 Drying and conditioning

Dry (or stove) and age (if applicable) each coated test panel for the specified time and under the conditions specified by contract between the interested parties. Before testing, condition the test panels at a temperature of (23 ± 2) °C and relative humidity of (50 ± 5) %, unless otherwise specified, for a minimum of 16 h.

Fingerprints, dust or other contamination on the surface results in lower accuracy. The coated panels should therefore be stored and handled in an appropriate way.

7.4 Thickness of coating

Determine the thickness, in micrometres, of the dried coating by one of the procedures specified in ISO 2808. The minimum dry-film thickness of the coating should preferably be 30 µm.

8 Procedure

8.1 Calibration of the instruments

Calibrate the instrument using the procedures specified in Annexes A and B.

8.2 Ambient conditions

Unless otherwise specified, test panels shall be tested at (23 ± 2) °C and a relative humidity of (50 ± 5) % (see also ISO 3270).

8.3 Determination of pendulum damping time

Determine pendulum damping time on three different parts of the same test panel.

Place the panel on the table with the paint film uppermost. Gently bring the pendulum onto the panel surface.

Deflect the pendulum, without lateral displacement of the fulcrum, through the appropriate angle (6° for the König pendulum, 12° for the Persoz pendulum) and allow it to rest against the stop provided.

Release the pendulum and simultaneously start the stopwatch or other timing device.

NOTE 1 In the case of automatic versions, the damping time is measured automatically.

Record the time, in seconds, for the amplitude of swing to decrease from either 6° to 3° (König pendulum) or from 12° to 4° (Persoz pendulum).

NOTE 2 For the pendulum damping test using the König pendulum, it is common practice to measure the number of swings. The time for the amplitude of swing to decrease can be calculated by multiplying the number of swings by 1,4 s.

9 Expression of results

Record each result and the mean of the three determinations to the nearest second.

10 Precision

10.1 König pendulum

10.1.1 General

In 2006, an interlaboratory comparison (ILC) was carried out for the determination of the precision with König-pendulum. Eight laboratories participated in the ILC with different pendulum instruments. The standard panels are centrally coated with three different clear coat materials. For the ILC, the pendulum hardness was measured three times on each of two panels with one clear coating material, i.e. six measurements in total.

Deviations of precision can occur due to different substrates.

10.1.2 Repeatability limit, *r*

The repeatability limit, *r*, is the value below which the absolute difference between two test results (each mean of two panels with each three measurements) can be expected to lie when this method is used under repeatability conditions. In this case, the test results are obtained on identical material by one operator in one laboratory within a short interval of time using the standardized test method. In this document, *r* is 5 swings, with a 95 % probability.

10.1.3 Reproducibility limit, *R*

The reproducibility limit, *R*, is the value below which the absolute difference between two test results (each the mean of two panels with each three single measurements) can be expected to lie when this method is used under reproducibility conditions. In this case, the test results are obtained on identical

material by operators in different laboratories using the standardized test method. In this document, *R* is 10 swings, with a 95 % probability.

10.2 Persoz pendulum

10.2.1 Repeatability limit, *r*

The repeatability limit, *r*, is the value below which the absolute difference between two single test results, each mean of duplicates, can be expected to lie when this method is used under repeatability conditions. In this case, the test results are obtained on identical material by one operator in one laboratory within a short interval of time using the standardized test method. In this document, *r* is 3 % of their mean value, with a 95 % probability.

10.2.2 Reproducibility limit, *R*

The reproducibility limit, *R*, is the value below which the absolute difference between two single test results, each the mean of duplicates, can be expected to lie when this method is used under reproducibility conditions. In this case, the test results are obtained on identical material by operators in different laboratories using the standardized test method. In this document, *R* is 8 % of their mean value, with a 95 % probability.

11 Supplementary test conditions

If agreed, the following supplementary test conditions shall be specified, as appropriate, in addition to those specified in Clauses 5, 6 and 7:

a) type of substrate material, substrate thickness and surface preparation of the substrate;

b) method of application of the test coating to the substrate, including duration and conditions of drying between coats in the case of a multi-coat system;

c) duration and conditions of drying (or stoving) and ageing (if applicable) of the coating before testing;

d) thickness, in micrometres, of the dry coating and method of measurement in accordance with ISO 2808, and whether it is a single coating or a multi-coat system;

e) temperature and relative humidity of the test, if different from those specified in 8.2 (see ISO 3270).

12 Test report

The test report shall contain at least the following information:

a) all information necessary for complete identification of the product tested;

b) a reference to this document, i.e. ISO 1522:2022;

c) the method used, i.e. König or Persoz pendulum;

d) the items of supplementary information referred to in Clause 11;

e) a reference to the international or national standard, product specification or other document supplying the information referred to in d);

f) the results of the test, including the results of the individual determinations and their mean as specified in Clause 9;

g) any specific agreements between the interested parties;

h) any deviations from the procedure specified;

i) any unusual features (anomalies) observed during the test;

j) the date of the test.

Annex A
(normative)

Calibration of the König pendulum

A.1 Check the alignment of the pendulum and panel table as follows.

A.1.1 Place the polished glass panel on the panel table and gently bring the pendulum to rest on the surface of the glass. Be sure the pendulum oscillates freely. Mark the position of the pendulum. Take the pendulum from the glass surface and place it at 180° such that the front faces backward, and gently bring the pendulum to rest on the surface of the glass. Mark the position of the pendulum. This should be the same position as prior to turning. Take the pendulum from the glass surface and replace it in the correct position and bring the pendulum to rest on the surface of the glass.

A.1.2 Place a spirit level on the glass panel surface. Level the glass panel by means of the adjusting screws at the base of the instrument.

A.1.3 Clean the glass panel by wiping with a soft, lint-free cloth wetted with a suitable solvent.

A.1.4 Clean the fulcrum balls by wiping them with a soft tissue wetted with a suitable solvent. Leave the pendulum in ambient conditions and then bring it to rest on the glass panel.

A.1.5 Check the position of the scale relative to the pendulum pointer. With the pendulum at rest, its pointer should indicate zero on the scale. If the pointer does not indicate zero, set the pendulum to zero as per manufacturer description.

A.2 Check the duration of the pendulum swing on the glass panel as follows.

A.2.1 Deflect the pendulum through 6°, release it and simultaneously start the stopwatch or other timing device.

A.2.2 Determine whether the time for 100 swings of the pendulum is (140 ± 2) s.

A.2.3 If the measured time is less than that specified, move the weight downward. Continue adjustments until the specified time is obtained. If adjustments do not give the required time, the instrument shall be judged faulty.

A.3 Check the duration of damping of the pendulum on the glass panel as follows.

A.3.1 Deflect the pendulum through 6°, release it and simultaneously start the stopwatch or other timing device.

A.3.2 Determine whether the time for the amplitude of swing to decrease from 6° to 3° is (250 ± 10) s (corresponding to 172 to 185 pendulum swings).